

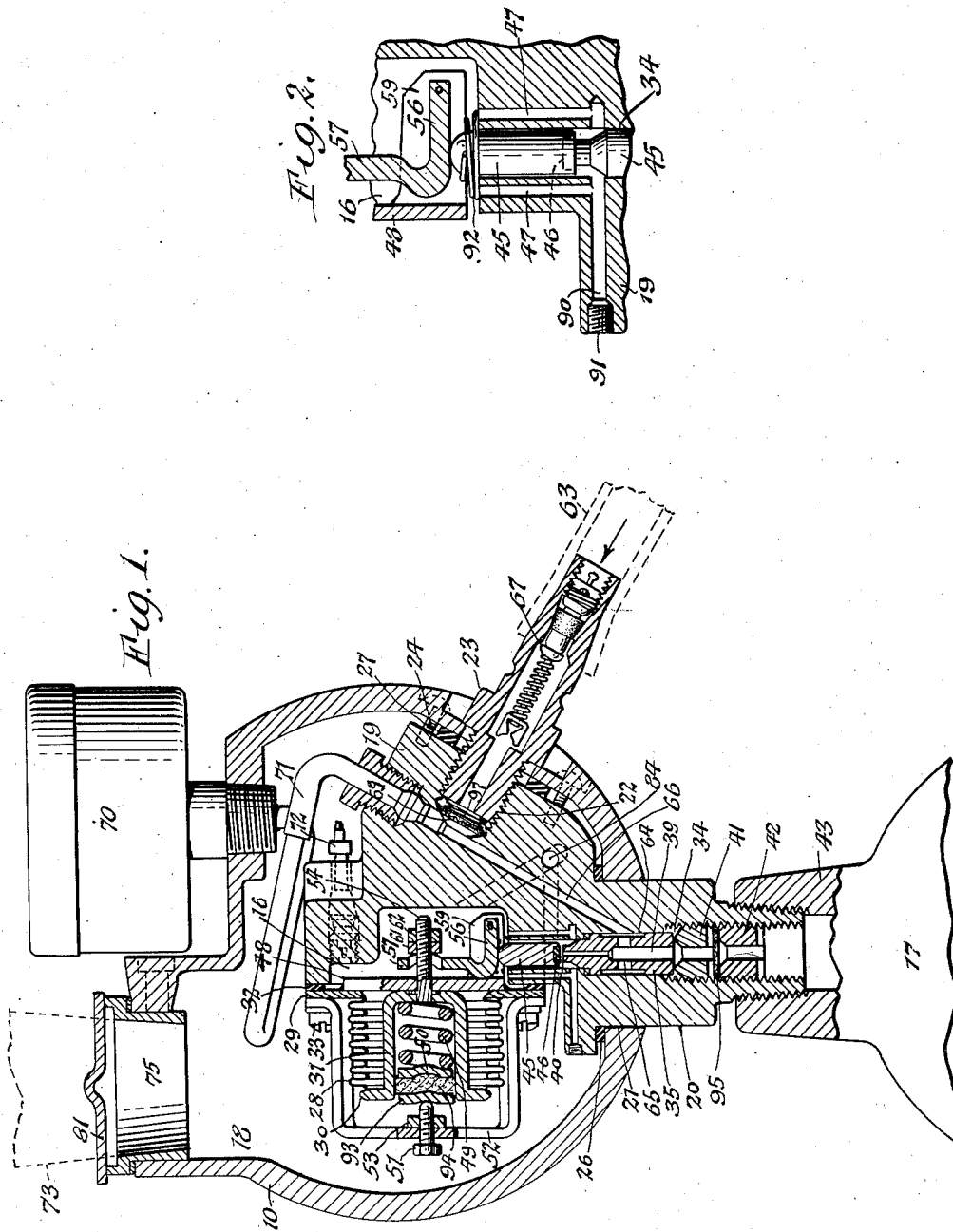
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PRESSURE REDUCER FOR BREATHING APPARATUS

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PRESSURE REDUCER FOR BREATHING APPARATUS

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2 Claims. (Cl. 50—26)

This invention relates to a pressure reducer or regulator for breathing apparatus which is more particularly designed for use by aviators or aeronauts to supply oxygen when flying in high altitudes, but this apparatus may be also employed advantageously by miners, firemen and others for supplying oxygen or other life preserving fluid when operating in an atmosphere containing noxious or poisonous gases.

It is the object of this invention to provide an improved apparatus of this character in which the pressure of the oxygen at which it is supplied from a suitable source is first reduced by a pressure reducing valve mechanism to a pressure which can be more easily controlled and then delivered to the user by a gas demand valve mechanism which operates in response to the breathing action of the user.

This application is a division of application Serial No. 466,165, filed November 19, 1942.

In the accompanying drawing:

Fig. 1 is a vertical transverse section of the apparatus embodying this invention.

Fig. 2 is a fragmentary vertical section, on an enlarged scale, of the pressure reducing valve and associated parts.

In the following description the reference numerals indicate corresponding parts in both figures of the drawing.

The numeral 10 represents the main hollow enclosing case or housing of the apparatus in which the various working elements of the apparatus are mounted and which preferably has the form of a cylinder.

The space within the enclosing case is divided by a partition having the form of a body 19 into a receiving or reducing chamber 16 which receives the oxygen at low or reduced pressure from a high pressure source and a delivery or respiration chamber 18 into which the oxygen is transferred at atmospheric pressure from the receiving chamber and from which the oxygen is delivered to the aviator in accordance with his demand for the same. The receiving chamber is formed by a recess on the inner side of the partition body 19 and the delivery chamber is formed between this body and the case. The partition body may be variously constructed but, as shown in the drawing, the same consists of a block of metal 19 which is arranged within the case and has its lower end resting on the bottom thereof and one of its sides arranged adjacent to a side of this case. On its underside the partition body is provided with a neck 20 which projects downwardly through an opening 21 in the bottom of

the case and on its lateral side the same is provided with an internally threaded socket 22 into which the externally threaded inner end of a tubular body 23 of a replenishing check valve is screwed so as to project laterally therefrom through an opening 24 in the adjacent side wall or part of the case. The partition body is secured firmly to the case side wall by screws 25 and airtight joints are produced between the same and the case wall by gaskets or soft washers 26, 27 surrounding the neck 20 and the valve body 23 and clamped between the respective parts of the case side wall and the partition body 19, as shown in Fig. 1.

The partition body 19 forms a stationary part or wall of the receiving chamber 16, the open inner side of which communicates with a flexible diaphragm 28 preferably of bellows form which is capable of expanding and contracting. The inner end of this bellows is fixed and connected to a supporting ring 29 mounted on the partition body 19 around the open side of the receiving chamber. The outer movable end of the bellows diaphragm is connected to an external flange 30 formed at the outer end of a tubular plunger 31 arranged within the bellows. A gasket 32 is interposed between the supporting ring 29 and the partition body and these members are detachably connected with each other by screws 33.

Pressure reducing means are provided which are responsive to the movement of the bellows and permit oxygen stored in a portable container, or obtained from any other source under relatively high pressure, to enter the receiving chamber at a reduced pressure, which means are preferably constructed as follows:

The portable oxygen container has the form of a metal bottle 17 the upper end of which has a hollow neck 43 which is detachably connected with the neck 20 of the partition body by a screw joint. A supply passage 34 extends lengthwise through the partition neck from the bottle to the receiving chamber. In aviation the pressure in the bottle 17 or other source from which the receiving chamber 16 is supplied with oxygen may be five hundred pounds which is too high for direct use by the aviator and it is therefore necessary to reduce the pressure of the oxygen in the receiving chamber to, say, twenty pounds in order that it can be handled safely, conveniently and comfortably by the aviator. For this purpose a reducing valve mechanism is employed which includes a valve tube 35 arranged in the passage 34 and provided with an inwardly facing external shoulder which bears against a gasket interposed

between this shoulder and an outwardly facing shoulder in said passage and provided at its inner end with a valve seat 40 which surrounds the longitudinal port or passage 39 in the valve tube. The valve tube is held in place by a tubular clamping nut 41 screwed into the passage 34 and bearing against the outer end of the valve tube and a tubular lock nut 42 screwed into the passage and engaging with the outer end of the clamping nut 41, as shown in Fig. 1. Within the inner part of the passage 34 is arranged a longitudinally movable reducing valve or closure 45, the outer or rear end of which is provided with a valve disk 46 adapted to engage with the seat 40 on the valve tube and the inner end of which projects into the lower part of the oxygen receiving chamber. Upon moving the closure or reducing valve 45 inwardly away from the seat 40 the port 39 is uncovered and oxygen is permitted to flow from the bottle or other source into the receiving chamber 16 and upon moving the valve outwardly and against the seat 40 the flow of oxygen is shut off. The valve 45 fits into the passage 34 loosely so as to permit the oxygen to flow past the same, and to prevent any oxygen in this passage from interfering with the free movement of this valve, a relief passage is provided in the partition body which extends from the receiving chamber to the passage 34 adjacent to the outer end of the reducing valve, which relief passage preferably comprises two vertical sections 47 formed in the partition body 19 on opposite sides of the passage 34 and opening at their upper ends into the receiving chamber 16 and a horizontal section 90 formed in the partition body and having its inner part communicating with the lower ends of the vertical sections 47 and the valve passage 34 adjacent to the lower end of the valve 45 and having its outer end closed by a screw plug 91, as shown in the drawing. The reducing valve is yieldingly moved upwardly into an open position in which it uncovers the port 39 by a spring 92 which is preferably of spiral form and rests at one end on the bottom of the receiving chamber 16, while its opposite end is connected with the upper end of the reducing valve, as best shown in Fig. 2.

The numeral 48 represents a vertical supporting bar which is secured to the ring 29 so as to extend across the opening in the latter and thus maintain communication between the receiving chamber 16 in the partition and the interior of the bellows. The inward movement of the plunger 31 is limited by engagement of its inner end with the outer side of the supporting bar 48 which acts as a stop for this purpose, as shown in Fig. 1. The plunger is moved inwardly and held yieldingly in engagement with the supporting bar 48 by adjustable spring means which in their preferred form are constructed as follows:

The numeral 49 represents a helical spring arranged in the plunger and bearing with its inner end against the inner end or closed bottom of the same. The outer end of this spring is backed up by adjusting and cushioning means which preferably comprise an inner follower 50 engaging the outer end of the spring 49, an outer follower 93 bearing against the inner end of an adjusting screw 51, and a cushion 94 of leather or the like interposed between these followers. The adjusting screw 51 works in a threaded opening formed in the central part of a supporting bracket 52 of U-shape which is secured to the inner bellows ring 29 by the same screws 33 which connect this

ring to the partition body 19, as shown in Fig. 1. Upon turning this screw in one direction the spring 49 will be strengthened and require greater gas pressure within the bellows to expand the same outwardly, while upon turning of this screw in the opposite direction, this spring will be weakened and require less gas pressure inside the bellows to expand the same. After the resistance of the spring 49 has been adjusted the screw 51 is held against turning by a jam nut 53 on this screw and bearing against the adjacent part of the bracket 52. The cushion 94 prevents vibration of the apparatus from affecting the adjustment of the spring 49.

The numeral 54 represents a shifting rod passing through a guide opening in the supporting bar and secured at this outer end to the inner end of the plunger while its inner end is arranged within the receiving chamber 16. Within the latter is arranged an L-shaped lever which turns in a vertical plane and has a lower horizontal arm 56 bearing against the upper end of the valve 45 and an upper vertical arm 57 provided with an opening through which the shifting rod 54 passes. The lower arm 56 is arranged between two lugs 59 projecting inwardly from the lower part of the vertical bar 48 and is pivoted thereto and the upper arm 57 bears with its inner side against an adjustable bearing screw nut 61 which is held in its adjusted position on the shifting rod 54 by a jam screw nut 62.

Whenever the bellows 28 is expanded by the pressure of the gas within the receiving chamber 16, the shifting rod 54 rocks the L-shaped lever 56, 57 outwardly, whereby the lower arm 56 of this lever forces the valve 45 against the seat 40 and prevents the further flow of oxygen gas from the bottle 17 or other source of supply into the receiving chamber. When the pressure of the fluid in the receiving chamber 16 drops to a predetermined pressure the spring 49 contacting the bellows rocks the L-shaped lever inwardly, thereby permitting the valve 45 to be opened, as shown in Fig. 1, by the pressure of the spring 92 and enabling further fluid to pass from this supply source into the receiving chamber.

By increasing the compression on the bellows spring 49 it will require a higher pressure of fluid in the receiving chamber 16 before the reducing valve 45 will be closed and upon decreasing the compression of this spring the reducing valve 45 will close when a lower fluid pressure has been reached in the receiving chamber 16. For the purpose of preventing any dirt or solid particles from passing from the container 17 to the receiving chamber separating means are provided consisting preferably of a screen 95 which is secured between the tubular screw nuts 41 and 42 and whereby any dirt or the like carried by the oxygen in the bottle 17 is intercepted and prevented from being inhaled by the aviator.

Replenishing means are provided whereby the bottle 17 and the fluid receiving chamber 16 may be replenished from an oxygen tank or other main source in which a comparatively large volume of this fluid is stored and transferred in smaller batches to this breathing apparatus for delivery at the proper pressure to the aviator as required. These replenishing means in the preferred construction shown in the drawing are organized as follows:

When replenishing of the supply of oxygen to the receiving chamber 16 from a main supply becomes necessary or desirable the outer end of the valve body 23 is temporarily connected by a sup-

ply hose 63 or the like with a tank in which a large volume of this gas is stored, which gas flows through a longitudinal passage in this valve body to the longitudinal passage 39 in the reducing valve tube 35 by a transfer conduit consisting of an annular passage 64 formed on the periphery of the valve tube 35 within the opening 34 of the neck 20 and communicating with the longitudinal passage 39 of the valve tube by a plurality of radial openings 65 in this tube, and an inclined passage 66 formed in the partition body 19 and extending from the inner end of the replenishing valve body 23 to the annular passage 64, as shown in Fig. 1.

Within the check valve body 23 is arranged a check valve 67 of any suitable construction, such, for example, as that commonly used in the filling nipples of pneumatic tires for automobile wheels, whereby gas under pressure is permitted to flow forwardly from the main supply tank through the passages formed respectively in the replenishing valve body, the partition body and the valve tube 35 to the outlet at the upper end of the latter and to the neck of the bottle 17, but backward flow of this gas through the replenishing valve body is prevented. It is therefore possible by these means to transfer gas from the main storage tank to the bottle and to the passage or port leading to the receiving chamber 16 by merely attaching the hose 63 to the outer end of the valve body 23 and maintaining such connection until the desired amount of gas has been admitted to the bottle and the passages connected therewith after which the hose 63 is detached from the valve body 23, whereby the transfer of gas will cease and backward flow of gas will be automatically prevented.

For the purpose of preventing any dirt, dust or large particles from passing from the main gas supply tank into the breathing apparatus the inner end of the check valve body is provided with a screen 69 which separates such material from the gas and holds it back in the body of this valve until the apparatus can be cleaned, thereby preventing such material from interfering with the proper functioning of the parts with which the gas comes in contact as well as preventing the aviator from inhaling the same. In the preferred construction the screen 69 is seated on a shoulder at the inner end of the socket in the partition body which receives the body 23 of the main check valve and is held thereagainst by a spring 97 interposed between this screen and the inner end of the valve body 23, as shown in Fig. 1.

In order to enable the aviator or other user of this apparatus to observe the pressure at which the gas is being supplied to the apparatus, gage means are provided which comprise a pressure responsive gage 70 which may be of any suitable construction and which is mounted on the upper side of the case of the apparatus so that the aviator can conveniently read the indicator of the gage. The mechanism of the gage may be of the usual pressure responsive type now in common use and a branch tube 71 may be employed which connects the passage 66 adjacent to the check valve body 23 with the inner part of the gage as shown in Fig. 1. This branch tube consists preferably of flexible metal so that the same can be bent for convenience in assembling and disassembling the parts with which the gage is associated. For the purpose of preventing excess pressure in the receiving chamber 16 a safety or automatic blow-off valve 72 is provided whereby gas will be

permitted to escape from this receiving chamber to the delivery chamber 18 in case the pressure within the receiving chamber rises above a predetermined normal due to leakage. This safety valve may be of usual and well known construction, such as the spring loaded safety valves now in common use, and the same may be located in any available part of the apparatus but, as shown in Fig. 1, the same is arranged in an opening formed in the upper part of the partition body 19 and extending from the receiving chamber 16 to the delivery chamber 18. When therefore an excessively high pressure exists in the receiving chamber the safety valve opens automatically and permits sufficient gas to escape to the delivery chamber as will reduce the pressure in the receiving chamber to the desired point.

The receiving chamber 16 is connected with the respiration chamber 18 in any suitable manner, as for example by a restoring passage 84 formed in the partition 19 and controlled by a demand valve mechanism which operates in response to the rise and fall of the gas pressure in the chamber 18, as described in the copending United States patent application Ser. No. 466,165 referred to heretofore.

The oxygen is withdrawn from the delivery chamber by inhalation of the aviator through the medium of an inhaling apparatus or mask which is applied to the face of the aviator and which is provided with an inhaling tube 73 of the usual character. When the aviator wishes to inhale oxygen from the delivery chamber the inlet of this inhaling apparatus is inserted in a tubular socket 75 on the case of the breathing apparatus.

When the breathing apparatus is not in use the outlet opening is closed by a lid 81 which is movably mounted on the adjacent part of the case.

In order to use the breathing apparatus the lid is lifted and the inlet of the inhaler inserted into the gas outlet of the delivery chamber.

As depletion of oxygen occurs in the delivery chamber the volume of oxygen withdrawn is automatically replenished by oxygen restoring means which may be constructed in accordance with the disclosure in said application.

It is to be understood that the term "oxygen" used in the specification and claims of this application is intended to include any respirant which may be supplied to a person by this breathing apparatus, such as oxygen, air, medicated vapors and like fluids or gases.

I claim as my invention:

1. A pressure reducer for breathing apparatus comprising a case, a body arranged within said case and having a receiving chamber and an oxygen conduit leading to said chamber, a bellows diaphragm forming a wall of said chamber and having one end opening into the same, a hollow plunger arranged within the bellows diaphragm and having its outer end connected with the corresponding end of said bellows diaphragm, a spring arranged in said plunger and bearing at its inner end against the corresponding end of the plunger and at its outer end against a rigid support, and a reducing valve mechanism for controlling the flow of oxygen from said conduit into said chamber, including a valve tube arranged in said conduit and having a valve seat, a valve member movable toward and from said seat, an L-shaped lever arranged within said chamber and engaging with said valve member, a bar mounted on said body across said bellows diaphragm and having lugs on which said lever

is pivoted, and a shifting rod passing through said bar and having its opposite ends connected with said lever and with the inner end of said plunger, respectively.

2. A pressure reducer for breathing apparatus comprising a case, a body arranged within said case and having a receiving chamber and an oxygen conduit leading to said chamber, a bellows diaphragm forming a wall of said chamber and having one end opening into the same, a hollow plunger arranged within the bellows diaphragm and having its outer end connected with the corresponding end of said bellows diaphragm, and a reducing valve mechanism for controlling the flow of oxygen from said conduit into said chamber including a valve tube arranged in said conduit and having a valve seat, a valve member movable toward and from said seat, an L-shaped lever arranged within said chamber and having

one arm engaging with said valve member, a bar mounted on said body across said bellows diaphragm and having lugs on which said lever is pivoted, a shifting rod passing through said bar and having its opposite ends connected respectively with the other arm of said lever and with the inner end of said plunger, and means for yieldingly moving said bellows diaphragm into its contracted position, including a spring arranged within the plunger and bearing with its inner end against the inner end of the plunger, an inner follower bearing against the outer end of said spring, a cushion bearing against said inner follower, an outer follower bearing against said cushion, an adjusting screw engaging said outer follower, and a bracket which is mounted on said body and which supports said screw.

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